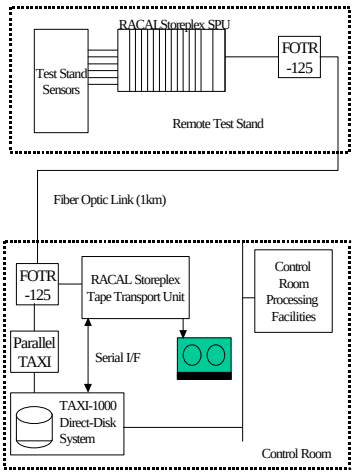
NASA Office of Technology Transfer

John C. Stennis Space Center

Dual-Use Activity Answers Collection Problems

Improvements to data collection software allows acquisition of real-time data necessary in testing rocket engines and other propulsion components.



Data Flow Architecture with Parallel Taxi Interface was implemented into the Stennis "A" test area High Speed Data Acquisition to provide a Disk Recording System (DRS).

The TAXI-100 System was developed jointly by Integrated Systems Consultants (ISC) of San Jose, CA. and Omni Technologies of New Orleans, LA. under a Cooperative Agreement with the NASA Office of Technology Transfer. The system has real-time remote hardware demultiplexing capability that provides channelized data to the control station across a fiber optic link. This capability extends the present product lines of ISC and Omni to provide the direct-to-disk recording through the Racal Storeplex interface with the TAXI system.

High-speed data provides valuable information about tests conducted with rocket engines and other propulsion components. Providing timely access to this data has been an issue in the past. Through the Dual-Use Development Program as NASA's Stennis Space Center (SSC), direct-to-disk storing capabilities for high speed data acquisition systems are now available through Integrated Systems Consultant's TAXI-100 Direct-to-Disk system. The TAXI-100 Direct-to-Disk system works through the Racal Storeplex system in conjunction with system integration software, Disk Recording System (DRS), developed by Boeing test operations at SSC to provide the high speed data significantly faster with fewer errors than was available with the previously used Racal Storeplex recordings.

HOT Points

- **Provides timely access**
- **Direct-to-disk storage capability**
- **Reduces error**
- **PC compatible**
- **Increases data integrity**
- **Utilizes fiber-optic link**
  Provides time saving in pretest preparations

The TAXI-100 Direct-to-Disk system was developed jointly by Integrated Systems Consultants (ISC) of San Jose, CA, and Omni Technologies of New Orleans, LA. under Cooperative Agreement NCC13-00006 with the NASA Office of Technology Transfer. The system has a real-time remote hardware demultiplexing capability that provides channelized data to the control station across a fiber optic link. The Cooperative Agreement between NASA, ISC and Omni, who developed the fiber optic interface, provides acquisition solutions for customers using coax to fiber conversion solutions such as the FOTR-125 fiber link. The TAXI-100 card developed by ISC provides PC-based direct-to-disk solutions for the Racal Storeplex system and other acquisition front-ends for industry where sustained data streams of 10 Mbytes per second or more are required.

PROBLEM DESCRIPTION

NASA rocket testing at Stennis Space Center requires acquisition of high-speed data during tests with the ability to transfer high-volume data to remote control stations and engineering management. The control, recording, and post-processing equipment of the facility are located in a control room at a safe distance from the test stand. Heretofore, the transfer of data from the instrumentation to the post-processing equipment has entailed post-test downloading of the data from Racal tapes via software, requiring many hours to days of post-test reduction before the data could be viewed in a channelized format. In addition, hours were spent in pre-test preparation of the recording tapes to ensure their integrity. Despite these efforts, there were occasions where single sample errors were introduced into the data by the tapes.

The present high-speed data acquisition system uses Racal Storeplex Recorders, which are commercially available multichannel recorders. Racal methods involve the use of real-time programmable logic of the parallel bus within the Racal recorder. Without extensive modifications, the test stand configuration required that the high-speed data continue to route through the Racal Storeplex tape transport units.

One method of demultiplexing the data using the Racal Storeplex system required the fabrication of a new card as an interface to existing commercial off the shelf products (COTS) to extract the channelized data from the proprietary format. The TAXI bus is a serial bus used between the Racal front-end and the recording unit. By extracting the data from the Racal front-end, the data can then be recorded directly to disk, which provides a recording media that requires less pretest maintenance and is less susceptible to sample recording errors.

SOLUTION

The TAXI Direct-to-Disk interface in conjunction with the Disk Recording System (DRS) software developed by the SSC Boeing group supplies a solution that provides higher integrity data that can be processed and made available to the customer within hours. The TAXI Direct-to-Disk interface is a special purpose interface circuit developed by ISC for demultiplexing data from a Racal Storeplex (or equivalent) multichannel recorder onto one or more hard disks that reside in, and/or are controlled by, a personal computer (PC). (The name “TAXI” is the acronym for “transparent asynchronous transceiver interface”). The installation of the TAXI Direct-to-Disk interface, in conjunction with other modifications, causes the transfer of data to be recorded directly to disk so it can be extracted and analyzed after the test.

The instrumentation is connected to the input terminals of the signal-processing unit of multichannel recorder by standard coaxial cables. The coaxial output of the signal-processing unit is converted to fiber-optic output by means of a commercial coaxial cable/fiber-optic converter (that is, a fiber-optic transceiver) designed by Omni Technologies Inc specifically for this application. The fiber-optic link carries the data signals to an identical fiber-optic transceiver in the control room. On the way to the TAXI Direct-to-Disk interface, the data signals are processed through a companion special purpose circuit denoted by the similar name “parallel TAXI interface.”

The TAXI Direct-to-Disk interface is implemented by means of field-programmable gate arrays (FPGAs), memory chips, and other integrated circuits on a printed-circuit board that conforms to the peripheral component interface (PCI) standard and is denoted the TAXI-100 card. The TAXI-100 card performs real-time demultiplexing of the data signals from the parallel TAXI Direct-to-Disk interface to individual channel files within the host PC. The data is provided in a layered interface that consists of the TAXI physical layer with the Racal proprietary data format contained in the application layer. The application layer is stripped off by the parallel TAXI Direct-to-Disk inter-face.

Parallel clock and data signals containing the Racal proprietary data format are received by the TAXI-100 card in the parallel format and demultiplexed, according to formats extracted from within the data. Other proprietary programmable logic chips provide for the management and buffering of the channel blocks until they are presented to the host PC across a PCI bus interface. Real-time software drivers running under the Microsoft NT 4.0 operating system provide for real-time handling of interrupts and buffering onto small computer systems interface (SCSI) disks in individual channel files. A host graphical user interface enables the user to select recorder channels.

A system of five TAXI-100 cards was implemented into the Stennis "A" test area High Speed Data Acquisition System (HDAS) to provide a Disk Recording System (DRS). The DRS consists of a "Bridge Computer", five Direct-to-Disk (DTD) recorders, and a Remote Control Panel Computer. While the TAXI-100 cards were developed to write data direct-to-disk, there were several additional requirements for integration into the test area system. These requirements included the ability to dynamically configure the DTD to record single or multiple channels and to start and stop the recorders from a control station remote from the DTD system. There were also requirements to be able to index the DTD data files to prevent overwriting of data and the ability to produce filtered frequency data form time series DTD data files. To meet these requirements, the Stennis Boeing test operations group wrote the DRS integration software that ties together the complete DRS system.

RESULTS

The DRS system implemented in the Stennis test area has monitored over 12 test firings to date with no malfunctions and has met or exceeded all expectations. The system has resulted in an ability to provide the high- speed data to the customer within an hour. The system requires less time for extracting the data (one hour compared to four to eight hours previously), which allows more time for data analysis. The result is the realization of a substantial savings in time, labor, and materials. There has also been an additional time saving in pretest preparation of the tapes, which is no longer required. In addition, there is increased data integrity due to the elimination of single sample errors experienced on occasion with the tape recording.

END USERS

NASA is one of the largest users of the Racal Storeplex Recorders. Racal has decided to eliminate that product line. This system can be extended into other NASA test facilities where the Racal Recorder are used, as well as, any other industry users of the Racal Recorders.

DUAL USE

The dual-use concept of product development is based on the sharing of costs, risks and successes between the government and a commercial partner. In these projects, NASA can contribute technology development, unique facilities and know how, engineering resources, and potentially some part of the funding. In turn, the commercial partner contributes its unique resources, facilities, manufacturing, and marketing capabilities. The result is an approach that provides considerable flexibility, and draws upon the capabilities of both parties.

For more information on the NASA Dual-Use Technology Development Program at Stennis, call (228) 688-1929, or access the web site at http://technology.ssc.nasa.gov.

Points of Contact

- **ISC Products**
  San Jose, CA.
  PH - 408 995-5421
  Web – www.intsyscons.com

- **Omni Technologies, Inc.**
  New Orleans, LA.
  PH – 540 288-8211
  Web – www.otiengineering.com

- **NASA Office of Technology Transfer**
  Stennis Space Center, MS.
  PH – 228 688-1929
  Web – technology.ssc.nasa.gov
  E-mail – technology@ssc.nasa.gov